DOCUMENT RESUME

ED 202 570 PS 012 120

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TITLE Piagetian Operative Level Related to Horizontality and Its Influence on Short-Term and Long-Term Memory.
PUB DATE Apr 81
NOTE 27p.; Paper presented at the Annual Meeting of the American Educational Research Association (Los Angeles, CA, April 13-17, 1981).

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Adolescents; *Children; Cognitive Ability; Cognitive Processes; *Developmental Stages; Measures (Individuals); *Memory; Middle Schools; Performance Factors; *Problem Solving; *Spatial Ability; Visualization
IDENTIFIERS Horizontality (Concept); *Piagetian Theory

ABSTRACT

A study designed to test the Piagetian theory that distinct stages in the organization of memory relating to horizontality correspond to successive stages in operative level was conducted with 154 twelve- to fourteen-year-old subjects. Loglinear and path analysis models were used to describe the association between operative level and spatial memory clinically assessed initially and again 6 months later. The analysis revealed a significant correlation between the two operative assessments and the two memory assessments. Subjects assessed as operative initially on an angle measure task had 2.6 times the odds of both correct initial and correct 6-month memories as those who were assessed as non-operative. Subjects assessed as operative initially on a bottles task had 8.7 times the odds of correct memory at 6-months as those who were not. Subjects assessed as operative initially on both tasks had 22 times the odds of correct memory at 6-months as those who were assessed as non-operative in both assessments. (Author/MP)

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Piagetian Operative Level Related to Horizontality and Its Influence on Short-Term and Long-Term Memory

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Presented at AERA
Los Angeles
April, 1981

Abstract

A study designed to test the Piagetian theory that distinct stages in the organization of memory relating to horizontality correspond to successive stages in operative level was conducted with 154 twelve to fourteen year old subjects. Loglinear and path analysis models were used to describe the association between operative level and spatial memory clinically assessed initially and again at six-months. The analysis revealed a significant correlation between the operative assessments (initially and six-months) and memory assessments (initially and six-months). Subjects assessed as operative initially on the angle measure task had 2.6 times the odds of both correct initial and correct six-month memories as those who were assessed as non-operative. Subjects assessed as operative at six-months on the bottles task had 8.7 times the odds of correct memory at six-months as those who were not. Subjects assessed as operative on both tasks had 22 times the odds of correct memory at six-months as those who were assessed as non-operative on both assessments.

Piagetian Operative Level Related to Horizontality and Its Influence on Short-Term and Long-Term Memory

Piaget and Inhelder (1973) have formulated an operative theory of memory which is based on the view that schemes of the intelligence which evolve through interaction with the environment are self-conserving. The operational level of an individual is determined by the schemes available for use in solving problems or in adapting to the environment. These schemes such as classification, seriation, rectangular coordination, etc., reflect an internal organization of thought processes used by a subject. The general cognitive structure develops in a hierarchical fashion in which later levels are more comprehensive and richer than previous levels and at the same time pave the way for succeeding levels of development.

Particular memories are embedded in and governed by the system of operative schemes. The theory predicts differences in the way an individual remembers an event and furthermore links these differences to the individual's operative development. The theory also accounts for longitudinal changes in the way an event is remembered. These changes may correspond to qualitative changes in the child's underlying schemes of the intelligence. Memory images reflect cognitive level initially and transformations of the memory image over time should be indicative of developing schemes.

In a study designed to investigate the effect of schemes relating to horizontality on memory, Piaget and Inhelder (1973), showed five to nine year olds a picture of a bottle inclined at a 45° angle. The bottle contained red liquid and depicted the level of the liquid as parallel to a

table top in the picture. Memory drawings were obtained after one hour, one week, and six months. The memory drawings from the initial sessions fell into categories which were consistent with expected responses. For example, children at five and six years of age often drew the liquid parallel to the bottom of the bottle. Seven to eight year olds generally produced drawings with the liquid inclined at arbitrary levels while correct remembrance did not appear before the age of eight to nine. About one-third of the eight year old subjects produced correct drawings while 75 percent of all five to seven year olds made mistakes. Hence, the memory drawings when compared with the age of the subject reflected the operational schemes of the subjects.

The general distribution of memory levels for the 55 subjects across age remained the same after six months. However, correct responses decreased for younger five to six year old subjects and increased for the older seven to nine year olds. All the younger subjects experienced mnemonic regression as well as three older subjects (seven to eight years of age). Two of the three older subjects had poor memories initially and regressed further after six months. Mnemonic stability also occurred across all memory levels as well as age groups and accounted for more than half of the final memory drawings. Approximately 30 percent (17 out of 55) of the subjects produced improvement in their drawings. Eleven of these advances were from the seven to nine year age group and most of these advances were to the highest level. However, several of the advances were transitional since the improvement was affected by means of a counter suggestion.

Subsequent studies (Furth, Ross, and Youniss, 1974; Liben, 1974; Liben, 1975b) which contained components designed to replicate and extend

Piaget and Inhelder's (1973) work on horizontality have found cross-sectional support of the operative view. In particular, developmental differences across ages in mnemonic performance were found by Furth et al. (1974) and Liben (1975b).

Longitudinally, Furth et al. (1974) found their data to be supportive to the Piagetian position. However, Liben (1974, 1975b) has argued that while Furth et al. (1974) have interpreted certain drawings as operatively poor, those drawings may be unscorable due to insufficient information concerning operative level. If these drawings are eliminated from the study by Furth et al. (1974), long-term improvements in memory are reduced (Liben, 1977).

In a study with kindergarten and fourth grade children Liben (1975b) found significant but weak correlation between operative level and ratings on recall tasks. In addition, long-term memory improvements could not be comprehensively tied to operative growth (Liben, 1975b).

Liben (1974) investigated long-term memory relating to horizontality in fifth grade subjects. Liben (1974) found a significant number of improvements in long-term memory, however, the number of regressions was not significantly greater than the number of improvements. Even though there was a significant relation between memory and operative level, the relation was weak and did not provide evidence for corresponding growth in operative and mnemonic levels (Liben, 1974).

Other related studies (Dahlem, 1968; Dahlem, 1969; Altemeyer, Fulton, and Berney, 1969; Liben, 1975a) have offered support for the Piagetian position on operativity and memory. A study (Samuels, 1976) investigating the influence of knowledge of conservation on memory provided only tentative support for the operative theory of memory.

and a third clinician. Inter-rater reliability was .96 on the balance beam task.

The memory drawings were rated independently by two researchers according to the mnemonic types described by Piaget and Inhelder (1973). All ratings were compared by the independent raters in committee with a third clinician. Inter-rater reliability for immediate recall memory was .98 and for six-month recall memory, .95.

The recognition task involved a choice by the subject of one drawing from among four, only one of which was correct. No errors were found in the recording of this task.

Problem solving performance was measured by the score achieved on the Advanced Metropolitan Problem Solving Test, Form F, administered in April at approximately the same time as the administration of the second balance beam task. The tests were machine scored by the test publishers and problem solving scores were categorized as high (at or above grade level) or low (below grade level).

The content of the test included (a) 4 one step addition, subtraction, multiplication and division problems, (b) 9 fraction and decimal problems, (c) 1 general solution problem, (d) 4 multiple step problems, (e) 3 geometry problems, (f) 3 ratio problems, (g) 2 percent problems, (h) 1 problem using negative integers, (i) 3 problems requiring the reading of charts, and (j) 5 number sentence problems.

Results

The data are described in the three-way classification array given in Table 1 consisting of each level and combination of levels of the variables cognitive level (A), long-term mnemonic level (B), and problem solving level (C)

the ages of twelve to fourteen with the association between operative level and spatial memory described using a loglinear model and path analysis model.

Method

Subjects

The experimental population consisted of 154 twelve to fourteen year old students from a suburban central New Jersey Middle School.

Procedures

A spatial memory task designed to have subjects utilize the schemes of the intelligence related directly to horizontality was administered. Each subject was also assessed initially and at six months with operative tasks designed to utilize the same schemes of the intelligence needed for success on the mnemonic task. Initial operative level was determined by evaluation of a subject's performance on a clinically administered angle measurement task described by Piaget, Inhelder, and Szeminska (1960) whose successful completion requires a mastery of rectangular coordination (Piaget, Inhelder, Szeminska, 1960).

A drawing of two supplementary angles as illustrated in Figure 1 was shown to each student. Then, the drawing was removed from view and placed behind the subject who was asked to make an exact copy of it.

Insert Figure 1 about here

The subject was informed that turning to study and/or measure the drawing was permitted. Pencils, triangles, rulers, compasses, and plastic strips were provided for use in measuring.

Subjects were rated on the angle measurement task according to the stages and substages described by Piaget, Inhelder, and Szeminska (1960). No stage I and only nine substage IIA responses were observed. Substage IIB is characterized by an inability to produce the slope of the angle while substage IIIA subjects may attempt to maintain the slope of the angle by holding a ruler steady (Piaget, Inhelder, Szeminska, 1960). However, both approaches are ineffective and it is not until substage IIIB that the angle inclination is referred to rectangular coordinate axes and hence is reproduced through measurement (Piaget, Inhelder, and Szeminska, 1960). Therefore, level IIIB responses were rated as high and others (IIA, IIB, IIIA) were rated as low in order to correspond to the mnemonic ratings.

The results from this task were scored objectively and checked for accuracy. The rare instances (2 out of 154) where ambiguity arose resulted in a review of these data by a committee of at least three researchers for a final determination and a consensus was reached in both cases.

The mnemonic task required the subject to remember a drawing of an inclined bottle containing some red liquid. The procedures for this task were derived from Piaget and Inhelder (1973). Remembrance of the inclined bottle is integrally tied to the idea of horizontality and the system of Cartesian coordinates (Piaget and Inhelder, 1973).

During the first interview the subjects were asked to examine and try to remember the drawing. They were informed that a drawing would be requested after the examination was completed. When the subject acknowledged that sufficient time was had for study, the card was removed from sight and a memory drawing was requested.

The memory drawings (immediate and six month) were rated independently by two researchers according to the mnemonic types described by Piaget and Inhelder (1973). To distinguish between correct drawings (Type VI) and drawings reflecting a transitional level (Type III), the level of the liquid was measured with a protractor. Only drawings where the level of the liquid was within 10° of the horizontal were rated as correct, a criterion used by Liben (1975b). All ratings were compared by the independent raters in committee with a third clinician. Interrater reliability was .96.

The operational assessment task given at the conclusion of the six-month memory drawing contained representative drawings from the three development levels described by Piaget and Inhelder (1973). These levels are directly comparable to the three mnemonic levels utilized in rating the memory drawings (immediate and six month). However, only eight subjects were rated at level 1 and therefore, level 1 and level 2 ratings were combined to form a low category. Level 3 observations formed the high category corresponding to the high rating on the memory drawings.

Hence, the initial and six-month assessments were rated as either high or low as well as the mnemonic assessments (immediate and six month). In all instances a high rating is supposed to reflect a utilization of horizontal/vertical schemes by the subject. A low rating would indicate that a subject has not utilized horizontal/vertical schemes in completing the task or that the appropriate schemes were not stable enough to permit consistent and comprehensive use.

Clinicians who administered the tasks were validated earlier through an observation of their testing of a subject by at least two other trained interviewers. Each clinician independently recorded the subject's performance

compare the conditional odds ratios for different levels of two or more conditional variables. For high assessment levels, the product of the path weights are used; for low levels, the reciprocal of the the path weights are used.

The AC and appropriate BC paths jointly indicate that a formal subject who recalled at six-months has 14.4, (3.2×4.5), times the odds of a high problem solving level as a subject with corresponding low assessments. Examination of the BC path weights with the AC path weights in Figure 2 reveals the following: a subject with a formal cognitive level and successful six-month recall has 5.4, (3.2×1.7), times the odds of a high problem solving level as a subject with a non-formal cognitive level assessment and a six-month recognition memory assessment; a subject with a formal cognitive level assessment and who recognized at six-months has 8.3, (2.6×3.2), times the odds of a high problem solving level as a subject who did not remember.

A subject who was non-formal and did not remember at six-months has .07, $(\frac{1}{3.2} \times \frac{1}{4.5})$, times the odds of a high problem solving level as a subject rated formal and who recalled at six-months. For a subject with a non-formal cognitive level assessment and recognition memory assessment, the odds of a high problem solving level is .18, $(\frac{1}{3.2} \times \frac{1}{1.7})$, times the odds as a subject with corresponding high assessments. Continuing to focus on the AC and BC paths, it can be observed that subjects with non-formal cognitive and no long-term memory assessments have .12, $(\frac{1}{3.2} \times \frac{1}{2.6})$, times the odds of a high problem solving as subjects rated as formal on cognitive level and who recognized at six-months. A subject with a non-formal cognitive level assessment and a who recognized has .8, $(\frac{1}{3.2} \times 2.6)$, times the odds of a high problem solving level as a subject with a formal cognitive level assessment and no six-month memory.

Maximum likelihood estimation procedures as described by Haberman (1978) were used.

Insert Table 1 about here

The loglinear model is used to describe the data in the four-way classification array found in Table 1 by providing estimates of the natural logarithms of the mean number of observations in each cell as a sum of effects attributable to each level and combination of levels of the classification variables: initial operative assessment (A), immediate memory assessment (B), six-month memory assessment (C), and six-month operative assessment (D) (Haberman, 1978).

Screening and stepping procedures described by Brown (1979) were used to identify the simplest model that adequately fits the data. Model 1 (AB, AC, BC, CD) was selected as the one providing the best fit of the data, explaining 94% percent of the variation not accounted for by the independence model (main effects model containing no interaction terms).

Model 1 (AB, AC, BC, CD) contains two-way interactions between initial operative assessment and immediate memory (AB), initial operative assessment and six-month memory (AC), immediate memory and six-month memory (BC), and six-month memory and six-month operative assessment (CD).

Model 1 is given by Equation (1):

$$\log \underline{m}_{ijk\ell} = \lambda + \lambda^{A}_{i} + \lambda^{B}_{j} + \lambda^{C}_{k} + \lambda^{D}_{\ell} + \lambda^{AB}_{ij} + \lambda^{AC}_{ik} + \lambda^{BC}_{jk} + \lambda^{CD}_{k\ell} \qquad (1)$$

where

(a) $m_{ijk\ell}$ is the expected frequency for cell ijkℓ and λ is a constant,

(b) λ_i^A, λ_j^B, λ_k^C, and λ_ℓ^D represent estimates of the effects attributable to the i^{th} level of A, j^{th} level of B, k^{th} level of C, and ℓ^{th} level of D, respectively, and

(c) λ_{ij}^{AB}, λ_{ik}^{AC}, λ_{jk}^{BC}, and $\lambda_{k\ell}^{CD}$ represent the two-way association effects.

Table 1 gives the expected cell counts in parentheses for the model described by Equation (1). The odds in favor of immediate recall (B) conditioned on the subject's initial operative assessment (A) and six-month memory assessment (C) are given in Equation (2):

$$\frac{m_{i2k\ell}}{m_{i1k\ell}} = \frac{e^{\lambda_2^B + \lambda_{i2}^{AB} + \lambda_{2k}^{BC}}}{e^{\lambda_1^B + \lambda_{i1}^{AB} + \lambda_{1k}^{BC}}} \qquad (2)$$

and can be seen to be conditionally independent of the six-month operative assessment (D). In general, the odds in favor of a mnemonic assessment will be conditionally dependent on only those variables present in the selected loglinear model and contained in significant interactions with the variable under study.

The expected cell counts in Table 1 were used to derive the 95 percent confidence interval estimates in Table 2 of the odds of successful immediate recall as a function of the subject's initial operative and six-month memory assessments.

Insert Table 2 about here

Table 2 shows that regardless of other conditioned assessments, a subject with a high initial operative assessment has 2.6 times the odds of successful immediate memory; a subject with a high six-month memory assessment has 2.85 times the odds of successful immediate memory.

Using the expected cell counts in Table 1, the 95 percent confidence interval estimates in Table 3 for the odds of successful six-month memory were derived. The odds of successful six-month memory are conditioned on initial operative assessment, immediate memory, and six-month operative assessment.

Insert Table 3 about here

Table 3 shows that regardless of other conditioned assessments, a subject with a high initial operative assessment has 2.6 times the odds of successful six-month memory; a subject with high immediate recall has 2.85 times the odds of successful six-month memory; a subject with a high six-month operative assessment has 8.69 times the odds of successful six-month memory.

The association among initial operative assessment (A), immediate memory (B), six-month memory (C), and six-month operative assessment (D) described in Tables 2 and 3 is represented graphically in the Path Analysis of Figure 3.

Insert Figure 3 about here

All pairs of assessments that are conditionally correlated are connected with paths. The magnitude of the conditional association between any two variables say, A and B, given a fixed assessment for a third variable C, is measured as the ratio of the conditional odds of a high variable A outcome given a high variable B outcome to the conditional odds of a high variable A outcome given a low variable B outcome. The conditional odds ratio or relative odds between A and B is shown in Figure 4 as the path weight between A and B (2.6). In general, the relative odds between two variables is symmetric and this is indicated by the double headed paths in Figure 3.

The AB path is interpreted as meaning that given fixed outcomes of the other conditioning variables a subject with a high initial operative assessment has 2.6 times the odds of successful immediate memory. Similarly, the BC path shows that a subject with high immediate recall has 2.85 times the odds of recall at six months. The CD path indicates that a subject rated high on the six-month operative assessment has 8.69 times the odds of successful recall at six months as a subject rated low when the levels of the other variables are fixed.

The lack of a path, say BD for example, means that those subjects with the same six-month memory assessment (high or low) have the same odds of a high six-month operative assessment as those with a low or high immediate recall. Thus, for example, the variables B and D while not conditionally correlated may or may not be correlated in general.

Conditional odds ratios for two or more conditional variables are computed by finding the product of the path weights for high assessment levels. For a low assessment level, the reciprocal of the path weight is used. Hence, the AB and BC paths jointly indicate that a subject with

both high initial operative and six-month memory assessments has a 7.41 (2.6 × 2.85) times the odds of successful immediate memory as a subject with corresponding low assessments.

Examination of the AC and BC paths in Figure 3 reveals that for the group with high initial operative and immediate memory assessments, the odds of successful six-month recall is 7.41 (2.6 × 2.85). Additionally, if the subject has a high six-month operative assessment, the odds of successful six-month memory becomes 64.39 (2.6 × 2.85 × 8.69). If the immediate memory assessment is low, the odds become 7.92 $\left(2.6 \times \frac{1}{2.85} \times 8.69\right)$ or if the six-month operative assessment is low the odds become .85 $\left(2.62 \times 2.85 \times \frac{1}{8.69}\right)$. Subjects with high initial and six-month operative assessments have 22.59 (2.6 × 8.69) times the odds of successful six-month memory as subjects with corresponding low assessments. If the initial operative assessment is low, the odds become 3.34 $\left(\frac{1}{2.6} \times 8.69\right)$. Subjects low on both assessments have a corresponding odds of .04 $\left(\frac{1}{2.6} \times \frac{1}{8.69}\right)$.

It might be noted that the observed values in Table 1 show that eleven out of 154 (7 percent) of the subjects were rated high on the initial and low on the six-month operative assessments. This represents 28 percent (eleven out of forty) of the subjects rated high on the initial operative task. Since operativity is not generally considered to be reversible, possible explanations include methodical and/or assessment errors, non-equivalence of the two operative assessments or some explanation within the theoretical operative memory theory framework. Due to the extensive training and validation of the clinicians, the great care taken in the administration of all tasks, and the methods of scoring with subsequent checks, it is assumed that methodical and/or assessment errors are not responsible for the

eleven subjects in the high-low category. Since the initial and six-month operative assessment tasks are somewhat correlated, $\chi^2(1) = 3.65$, $p < .10$, caution is advised in concluding that one or both of the tasks do not require the utilization of horizontal/vertical schemes for successful completion. Rather, these results suggest that the operative tasks tap different as well as common aspects of the same schemes or operativity in general.

Both the initial operative assessment (requiring a subject to copy an angle with measuring tools available) and the six-month operative assessment (requiring a subject to judge the correctness of different inclined bottle drawings), according to Piaget, Inhelder, and Szeminska, (1960) tap in subjects the same schemes for successful accomplishment. It appears, in retrospect, that the angle measurement task may not have been the preferred initial operative assessment. Yet, had the six-month operative task been given initially, the potential for confounding error in subsequent tasks remains. (For example, subjects might have remembered one of the incorrect drawings shown, rather than the correct one they were asked to remember.)

Certainly the data do not provide conclusive evidence of task non-equivalence. Other explanations include the possibility of instability in the construction of the schemes of horizontality in some subjects. Specifically, the eleven subjects who went from a high initial operative assessment to a low six-month operative assessment may have been transitional with respect to operativity. The fact that these subjects were rated high on the initial operative assessment suggests that the schemes of horizontality are not totally absent. However, the low six-month operative assessment may reflect a lack of comprehensive and consistent use of these schemes.

It should also be noted that nine of the eleven subjects had low mnemonic ratings at six months.

Discussion

Regardless of possible explanations, the data do suggest the possibility of a nonequivalence of the initial and six-month operative assessment tasks. Therefore, operative growth and/or stability of the type discussed (Piaget and Inhelder, 1973) cannot be addressed.

The weak correlation between the initial and six-month operative assessment tasks suggests that different as well as common aspects of horizontality are utilized. Notice that the path analysis (Figure 3) shows very high relative odds for six-month memory for subjects who were successful on both operative tasks (22.59 times the odds of successful six-month memory). Subjects rated low on both operative assessments have a corresponding relative odds of .04 while subjects with a low-high profile have a corresponding relative odds of 3.34. In these instances, mnemonic trends are noted in the context of scheme stability over time and not in terms of operative growth.

Even though the overall results provide support for the Piagetian view of operative memory relating to horizontality, there were a few nonconfirming cases. For example, four subjects rated high on both operative assessments had low level memory assessments at six months. Nine other subjects had low ratings on both operative assessments and a high memory assessment at six months. For the former group it could be argued that four subjects had not engaged the appropriate schemes in the memory task or that operative level is merely a necessary condition not a guarantee of

precise memory. Perhaps some of those nine subjects in the latter group who drew the level of the liquid within 10° of the horizontal did so by accident. Regardless of how one interprets the results, the presence of other variables that mediate operativity and affect mnemonic performance is established for at least some subjects. Certainly a more differentiated level of operativity is suggested. It may be, too, that other variables such as motivation, figural impact, drawing ability, etc., provide explanation.

Generally, the analysis has shown that immediate recall depends on the initial operative assessment and six-month memory. Six-month recall depends on initial operative assessment, immediate memory, and six-month operative assessment. The Path Analysis in Figure 3 provides a measure of relative strengths for these associations and can be used to illustrate relative strengths of associations for variables that interact jointly. This was accomplished by loglinear and odds analysis without any prior assumptions about the relationships among the variables. Nevertheless, it is not surprising to find that not only operative assessments are important contributors to memory assessments but other memory assessments also contribute significantly to a given memory assessment. These results are within the Piagetian view, especially if as Piaget and Inhelder (1973) claim, that memory assessments reflect the operative schemes of the subject. The Path Analysis in Figure 3 is consistent with the theoretical model presented in Figure 2. Hence, the results of the analysis for the 154 subjects in this study can be interpreted as providing support for the Piagetian position.

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TABLE 1

Observed and Fitted Cell Counts for Cross-Classification of Six-Month Operative Assessment, Six-Month Memory, Immediate Memory and Initial Operative Assessment

Six-Month Operative Assessment	Six-Month Memory	Immediate Memory	Initial Operative Assessment	
			Low	High
L	L	L	29 (30.534)	5 (3.875)
		H	13 (12.477)	4 (4.113)
	H	L	6 (3.146)	1 (1.037)
		H	3 (3.672)	1 (3.145)
H	L	L	21 (19.159)	1 (2.432)
		H	7 (7.829)	3 (2.581)
	H	L	14 (17.158)	6 (5.659)
		H	21 (20.026)	19 (17.157)

TABLE 2

Ninety-Five Percent Confidence Intervals for Odds in Favor of Immediate Memory Conditioned on Initial Operative Assessment and Six-Month Memory

Initial Operative Assessment	Six-Month Memory	Odds in Favor of Immediate Memory
H	H	3.03 $^{+4.22}_{-1.76}$
	L	1.06 $^{+2.08}_{-.70}$
L	H	1.16 $^{+.94}_{-.52}$
	L	.41 $^{+.28}_{-.16}$
Relative Odds		
High Initial Operative Assessment vs. Low Initial Operative Assessment		2.6 $^{+3.15}_{-1.42}$
High Six-Month Memory vs. Low Six-Month Memory		2.85 $^{+2.8}_{-1.41}$

TABLE 3

Ninety-Five Percent Confidence Intervals for Odds in Favor of Six-Month Memory Conditioned on Initial Operative Assessment, Immediate Memory, and Six-Month Operative Assessment

Initial Operative Assessment	Immediate Memory Assessment	Six-Month Operative Assessment	Odds in Favor of Six-Month Memory
H	H	H	6.65 +17.96 -4.85
		L	.76 +2.54 -.58
	L	H	2.32 +8.10 -1.8
		L	.26 +2.01 -.23
L	H	H	2.55 +3.27 -1.43
		L	.29 +.64 -.20
	L	H	.89 +.82 -.42
		L	.10 +.22 -.07
Relative Odds			
High Initial Operative Assessment vs. Low Initial Operative Assessment			2.6 +3.78 -1.54
High Immediate Memory vs. Low Immediate Memory			2.85 +3.32 -1.53
High Six-Month Operative Assessment vs. Low Six-Month Operative Assessment			8.69 +11.2 -4.89

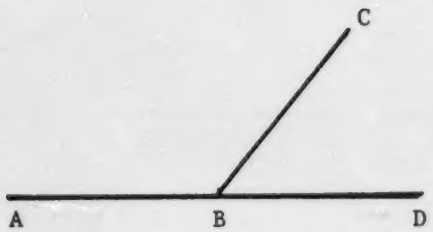

Figure 1. Angle measurement drawing.

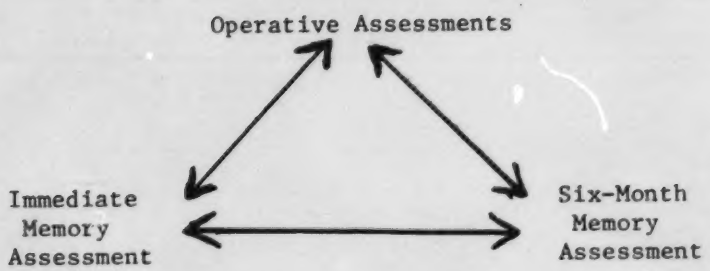

Figure 2. Piagetian model for spatial memory.

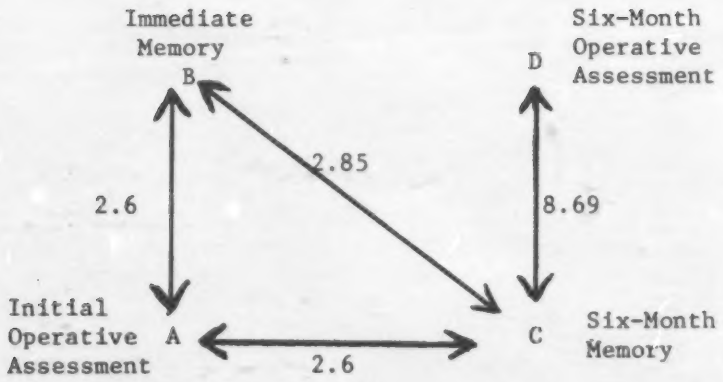

Figure 3. A path analysis illustrating the association between initial and six-month operative assessments and immediate and six-month memories.